1.0 Dewar Requirements

1.1 General Requirements

1.1.1 **Material**: The majority of the Dewar shall be fabricated from Aluminum, especially any part that will be exposed to a proton radiation beam. Copper shall not be used for any part of the Dewar assembly.

1.1.2 Split vacuum and cold shields are required to allow unobstructed access to the liquid nitrogen and liquid helium cold plate work surfaces.

1.1.3 Frequent internal layout changes over the lifetime of the Dewar are anticipated, thus durability is critical. Helicoil® inserts for cold plate and vacuum case holes are essential. Minimum hole depths of 0.25" with Helicoil® inserts in place are required.

1.1.4 The Dewar shall be designed in such a way that 2.25" wide tape cables with connectors (maximum connector dimensions 3.0" L x 0.5" W x 0.4" T) can be passed thru from the outside to inside the LHe shield. This may require non-circular shields and reservoirs, as indicated by the octagon referenced in **Figure 1**.

1.1.5 Reasonable attempts should be made to keep the overall Dewar weight as low as possible.

1.2 Dewar Exterior

1.2.1 **Outer Diameter**: The outer case diameter (excluding flanges) shall not exceed 16.0"

1.2.2 **Case Height**: The outer case height (excluding fill ports and top electrical feed-through shall not exceed 28.0"

1.2.3 **Case Breaks**: There shall be only one break point in the outer case, utilizing an O-ring and latches to provide the vacuum seal. All other interfaces on the outer case shall be welded.

1.2.4 The vacuum case shall be designed in such a way that it can be repositioned to put the radiation port directly behind the FPA under test.

1.2.5 **Vacuum Port**: The vacuum port shall be on the top of the Dewar, and shall terminate on an NW25 flange. A right-angle vacuum valve shall be included.

1.2.6 **Fill Ports**: There shall be three LN2 (Ø0.50" ID min) and one LHe (Ø0.75" ID min) fill ports. Stainless steel fill tubes are preferred, however other materials will be considered.

1.2.7 **Optical Port**: A side-looking optical port, with a minimum clear aperture of 2.00" is required, and should include ZnSe window.

1.2.7.1 The optical mount shall accommodate a 2.5" diameter X 6mm thick window

1.2.7.2 Provisions shall be made for easy replacement of the optical window

1.2.8 **Radiation Port**: A side looking radiation port, with a minimum clear aperture of 4.10" shall be located approximately 35° off-axis from the optical port.

1.2.8.1 The proton port will be covered with either 5-10 mil thick Kapton® film or 35-50µm Aramica® foil. The mounting ring design is critical since stress and tensile forces due to atmospheric pressure must be evenly distributed around the periphery of the film/foil window. A minimum of eight holes around the periphery of the mounting ring is required.

1.2.8.2 AFRL/IRREL will supply the Kapton® film and/or Aramica® foil.

1.2.9 Electrical Feed-throughs

1.2.9.1 General Feed-through Requirements: The side feed-throughs shall consist of a two-piece design: A mounting flange that is welded to the Dewar vacuum case and contains threaded screw holes, and a matching plate or ring that will used for hermetic connectors or epoxied cableways.

1.2.9.2 Top Feed-through: The top feed-through shall be sized to house a 32-pin circular (MIL-DTL-38999 type) hermetic connector. The minimum inside dimension of the hole thru the vacuum case is 1.25"

1.2.9.2.1 Cabling from this connector shall have it's own feed-through into the LN2 and LHe shields.

1.2.9.3 Side Feed-throughs:

1.2.9.3.1 There shall be 4 electrical feed-throughs designed to accommodate flex cables up to 2.25" wide and circular (MIL-DTL-38999 type) hermetic connectors of any size.

1.2.9.3.2 The side feed-throughs shall be placed approximately as shown in **Figure 1**.

1.2.9.3.3 The Dewar should be delivered with two full sets of blank connector mounting plates.

1.3 LN_2 Reservoir & Shield

1.3.1 LN_2 Volume: The LN_2 reservoir shall have a minimum capacity of 7 liters

1.3.2 LN_2 Shield

1.3.2.1 Spacing to Vacuum Shroud: The minimum distance between the inside of the vacuum shroud and the outside of the nitrogen shield or the LN_2 or LHe reservoirs, at any point, shall be 0.70" to allow for connector/cable routing.

1.3.2.2 Light Tight: The nitrogen shield shall have a light-tight mount to the LN_2 reservoir, and light-tight vacuum evacuation port.

1.3.2.3 Attachment Point: The LN_2 shield attachment point shall be located so as to allow unrestricted access to the LN_2 cold plate.

1.3.2.3.1 A two-piece design of the LN_2 cold shield is preferred, but not required.

1.3.2.3.1.1 The split should be located so as to allow unrestricted access to the LHe cold plate with only the end of the shield removed.

1.3.2.3.2 Attachment of the LN_2 shield to the LN_2 reservoir, and the LN2 shield halves (if applicable) using latches is preferred, but not required.

1.3.2.4 Optical Port: Provisions shall be made to allow the mounting of a 1" diameter optical filter on the nitrogen shield, within 1" of the cold aperture. This is the only location that can violate the 0.70" distance requirement of Section 1.3.2.1.

1.3.2.5 Radiation Port: The proton beam port in the LN_2 shield shall provide a minimum clear aperture of 4.10". The port will be covered with foil

that is blackened on the inside. Some provision for a light tight clamp around the foil periphery is required.

1.3.2.6 The LN_2 shield shall be designed in such a way that it can be repositioned to put the radiation port directly behind the FPA under test.

1.3.2.6.1 Attachment of the LN_2 shield to the LN_2 reservoir using latches is preferred, but not required.

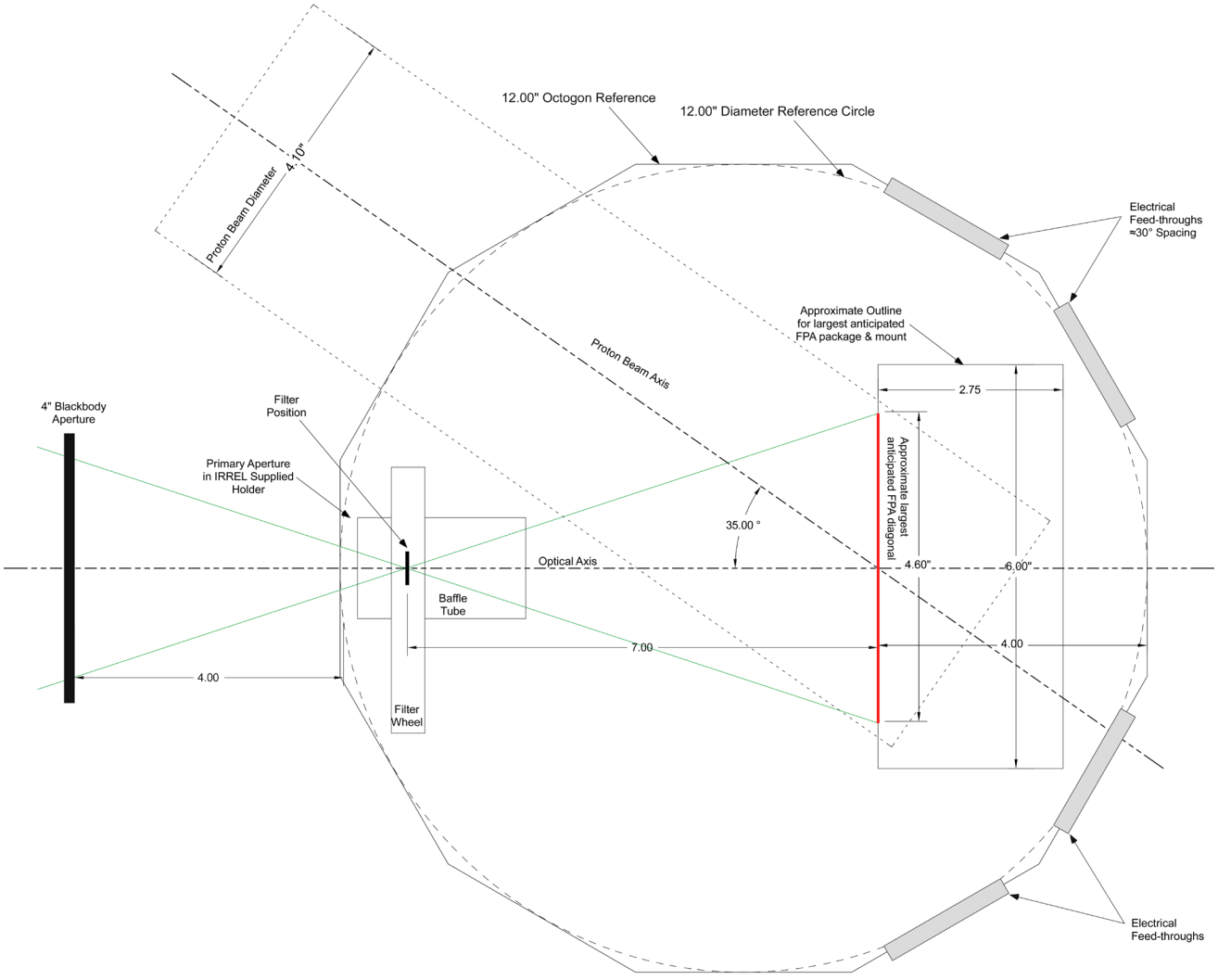

Figure 1. Large Format Dewar cold plate conceptual layout. Dimensions are in inches.

1.3.2.7 Electrical Feed-throughs:

1.3.2.7.1 Electrical feed-throughs into the LN_2 shield shall be in-line vertically with the feed-throughs on the Dewar case.

1.3.2.7.2 The feed-through design shall allow removal of the LN_2 shield without disturbing the cabling.

1.3.2.7.3 Provisions for routing the cables with the connectors in place are required. The cable routing would normally be performed with the nitrogen shield removed.

1.3.2.7.4 Provisions are needed to cold-station the cables to the nitrogen reservoir.

1.3.2.7.5 Feed-throughs shall be designed to be light tight.

1.3.2.7.6 Each feed-through must be able to accept two 2.25"x0.070" cables

1.3.2.7.7 The feed-throughs should consist of machined parts that are separate from the nitrogen shield, such that new parts can be machined that will accept different cables widths without requiring modifications to the nitrogen shield itself. A method for blanking off any/all unused path-throughs should be included with the Dewar.

1.4 LN2 Cold Plate

1.4.1 Hole Pattern / Hole Sizes: The hole pattern and sizes on the LN_2 cold plate are TBD, and will be supplied after contract award.

1.4.2 Heaters: The Dewar shall include a method for applying heat to the LN_2 cold plate to reduce warm-up time.

1.5 LHe Reservoir and Shield

1.5.1 LHe Volume: The LHe reservoir shall have a minimum capacity of 5 liters

1.5.2 LHe Shield

1.5.2.1 Spacing to LN_2 Shield: The minimum distance between the inside of the LN_2 shield and the outside of the LHe shield, at any point, shall be 0.70" to allow for connector/cable routing.

1.5.2.2 Light Tight: The helium shield shall have a light-tight mount to the LHe reservoir, and light-tight vacuum evacuation port.

1.5.2.3 Attachment Point: The LHe shield attachment point shall be located so as to allow unrestricted access to the LHe cold plate.

1.5.2.3.1 Attachment of the LHe shield to the LHe reservoir using latches is preferred, but not required.

1.5.2.4 Minimum Inside Height: The optical axis shall be a minimum of 4.75" from the cold plate surface, and the inside end of the LHe shield shall a minimum of 9.5" from the cold plate.

1.5.2.5 Optical Port: The AFRL supplied aperture holder (Figure 1) contains the limiting aperture for the system and the 9.7" length dimension in Figure 1 refers to the *minimum* distance desired from that aperture to the FPA surface. The aperture holder stack has 2 5/16" diameter mounting flange with a 4-bolt hole pattern on 1 7/8" centers. The stack itself is 1 ½ " O.D. and approximately 0.5" long overall. CAD rendering can be supplied later if needed.

1.5.2.6 Radiation Port: The proton beam port in the LHe shield shall provide a minimum clear aperture of 4.10". The port will be covered with foil

that is blackened on the inside. Some provision for a light tight clamp around the foil periphery is required.

1.5.2.7 The LHe shield shall be designed in such a way that it can be repositioned to put the radiation port directly behind the FPA under test.

1.5.2.7.1 In order to accommodate the optical and radiation ports, the LHe shield does not have to be circular, as long as requirements 1.3.2.6 and 1.5.2.7 are not violated.

1.5.2.8 Electrical Feed-throughs

1.5.2.8.1 Electrical feed-throughs into the LHe shield shall be in-line vertically with the feed-throughs on the Dewar case.

1.5.2.8.2 Feed-through design shall allow removal of the LHe shield without disturbing the cabling.

1.5.2.8.3 Provisions for routing the cables with the connectors in place are required. The cable routing would normally be performed with the helium shield removed.

1.5.2.8.4 Feed-throughs shall be designed to be light tight.

1.5.2.8.5 Each feed-through must be able to accept two 2.25”x0.070” cables

1.5.2.8.6 The feed-throughs should consist of machined parts that are separate from the helium shield, such that new parts can be machined that will accept different cables widths without requiring modifications to the helium shield itself. A method for blanking off any/all unused feed-throughs should be included with the Dewar.

1.6 LHe Cold Plate

1.6.1 **Hole Pattern / Hole Sizes**: The hole pattern and sizes on the LHe cold plate are TBD, and will be supplied after contract award.

1.6.2 AFRL/IRREL will be responsible for fabricating the internal FPA mounts, PCBs and aperture holders.

1.6.3 The Dewar shall include a method for applying heat to the LHe cold plate to reduce warm-up time.

1.7 Filter Wheel

1.7.1 A light-tight filter wheel capable of housing 4 - 6 1” O.D. optical filters or apertures shall be included as an option in the overall design.

1.7.1.1 The filter holder assembly and drive shaft must be positioned so as not to obstruct the 4.1” proton beam.

1.8 Dewar Handling

1.8.1 The Dewar shall contain pivot points that will allow it to be rotated and locked at 90°, 180° and 270° from normal while mounted in the Dewar stand, as shown in **Photo 1**.

1.8.2 The pivot points should be at or near the Dewars’ vertical center of gravity.

1.8.3 The Dewar should have two sets of carrying handles on opposing sides, one set above and one set below the pivot point.

1.8.4 The Dewar should include a handle/stand ring to allow it to stand inverted on a table or workbench for reconfiguration work.

1.8.5 The Dewar handles and pivot points shall be placed orthogonal to the optical axis, such that they do not interfere with the placement of a blackbody radiation source right up to the optical window, nor placing the proton port right up to the proton beam source shown below in **Photo 2**.

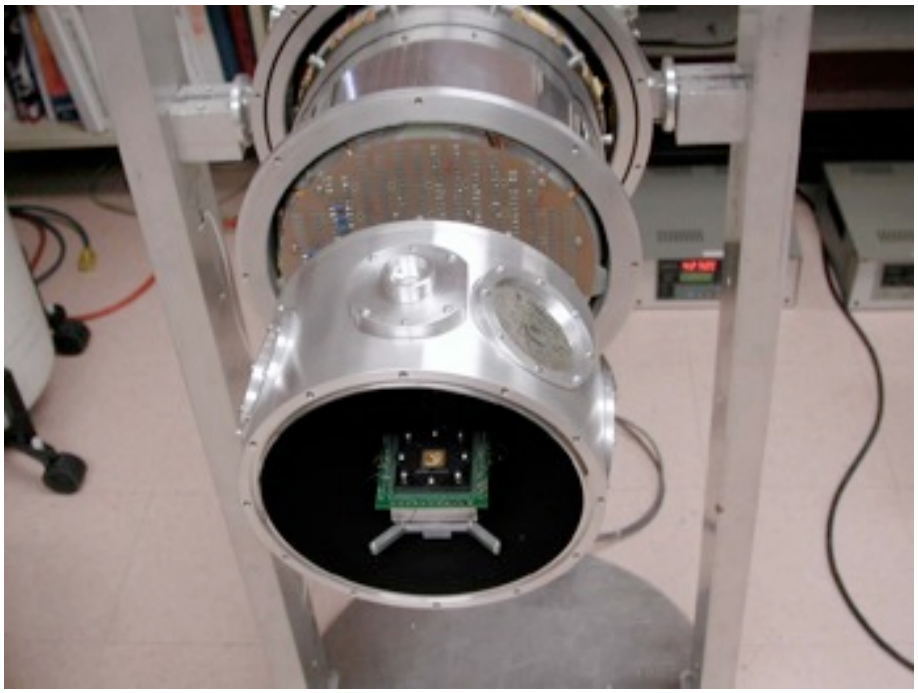

Photo 1: Example of a Dewar in a stand locked in the 90° position

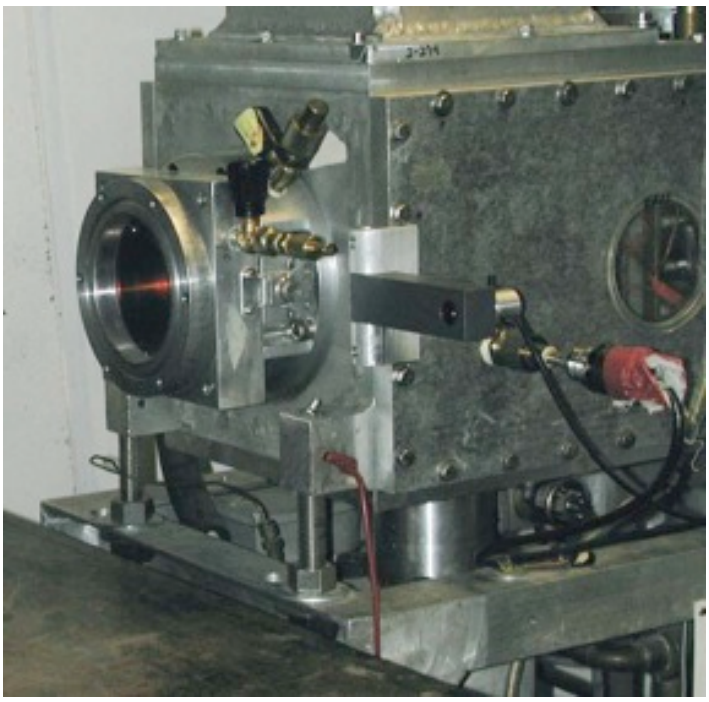

Photo 2. Proton beam source at the University of California, Davis. For reference, metal ring around the Kapton window seen at the left center of the picture has a four-inch inside diameter, and an outside diameter of approximately six inches.